Surface Fluxes in Under Weak Wind Conditions

Larry Mahrt
College of Oceanic and Atmospheric Sciences
Oregon State University
Corvallis, OR 97331
phone: (541) 737-5691 fax: (541) 737-2540 email: mahrt@oce.orst.edu

Grant #: N00014-01-1-0084
http://blg.oce.orst.edu/cblast-weakwind

LONG-TERM GOAL

The traditional bulk flux formula with Monin-Obukhov similarity theory, used in almost all numerical models, often behaves poorly in weak wind conditions. We will develop a new bulk formula for sea-surface fluxes, which is substantially improved for weak wind conditions.

OBJECTIVES

We propose to examine each of a number of physical mechanisms thought to be important for weak wind conditions by collecting aircraft and tower data in both open-ocean and fetch-limited conditions. This investigation relies on improved eddy correlation data and fast response observations of the wave field. Our contention is that existing analyses for weak wind situations are often strongly influenced by observational errors and analyses problems, which will be given special emphasis in this study.

APPROACH

We will be implementing eddy correlation and wind and temperature profile measurements on the CBLAST WHOI offshore tower near Martha's Vineyard. We are also designing LongEZ aircraft flights to study spatial variation of surface fluxes. With proper flight design, the combination of aircraft, tower and buoy flux data provides for more robust examination of the stress and surface flux fields. The aircraft data includes a faster thermistor, improved sea surface temperature and improved laser and scatterometer interrogation of the surface wave field. The processed data will be analyzed toward the goal of improving physical understanding and parameterization of sea surface fluxes and will be provided to LES and larger-scale modeling groups.

WORK COMPLETED

We have purchased the LiCOR 7500 gas analyzer, have completed calibration procedures and are performing outdoor tests locally. We participated in the pilot field program off of Martha's Vineyard in late July-early August with the LongEZ group. We have performed brief analysis of the preliminary data but are waiting for the fully processed data from NOAA-Idaho Falls and then will immediately begin quality control procedures.

RESULTS

Our plans for the 2002 summer observational period include the following instrumentation:

- In cooperation with Jim Edson, we will deploy sonic anemometers for momentum and virtual heat flux on the offshore tower .

- To compute vertical temperature gradients, thermocouples will be deployed at 12 levels. These observations will be carried out primarily by Jielun Sun and Sean Burns of the National Center for Atmospheric Research.

- In addition, redundant thermocouples will be deployed with the Campbell sonic anemometers for direct measurement of the sensible heat flux. The redundant thermocouples allow for some breakage of the fine wires, necessary for the sparser schedule of offshore instrument maintenance. Based on previous experience, we do not anticipate a high breakage rate over the sea in weak and moderate wind speeds.

- A LI-COR gas analyzer will be deployed with one of the sonic anemometers. Along with the fast response thermocouple, this will allow two independent measurements of the heat and moisture fluxes.

- A three-dimensional hot film anemometer will be experimentally deployed close to the sea surface to better capture the turbulence in thin stratified boundary layers where the sonic anemometers suffer from flux loss due to pathlength averaging.

- Three or more two-dimensional Handar sonic anemometers will be placed within the lowest 10 m to measure vertical structure of the wind field in weak wind very thin boundary layers.

IMPACT/APPLICATION

None

RELATED PROJECTS

None

PUBLICATIONS

None